GLOBAL SOLAR

“LIGHTWEIGHT PORTABLE POWER

BY GLOBAL

2003 TTP Service Power Expo,
NDIA Norfolk, VA, July 17

Presented by Scot Albright

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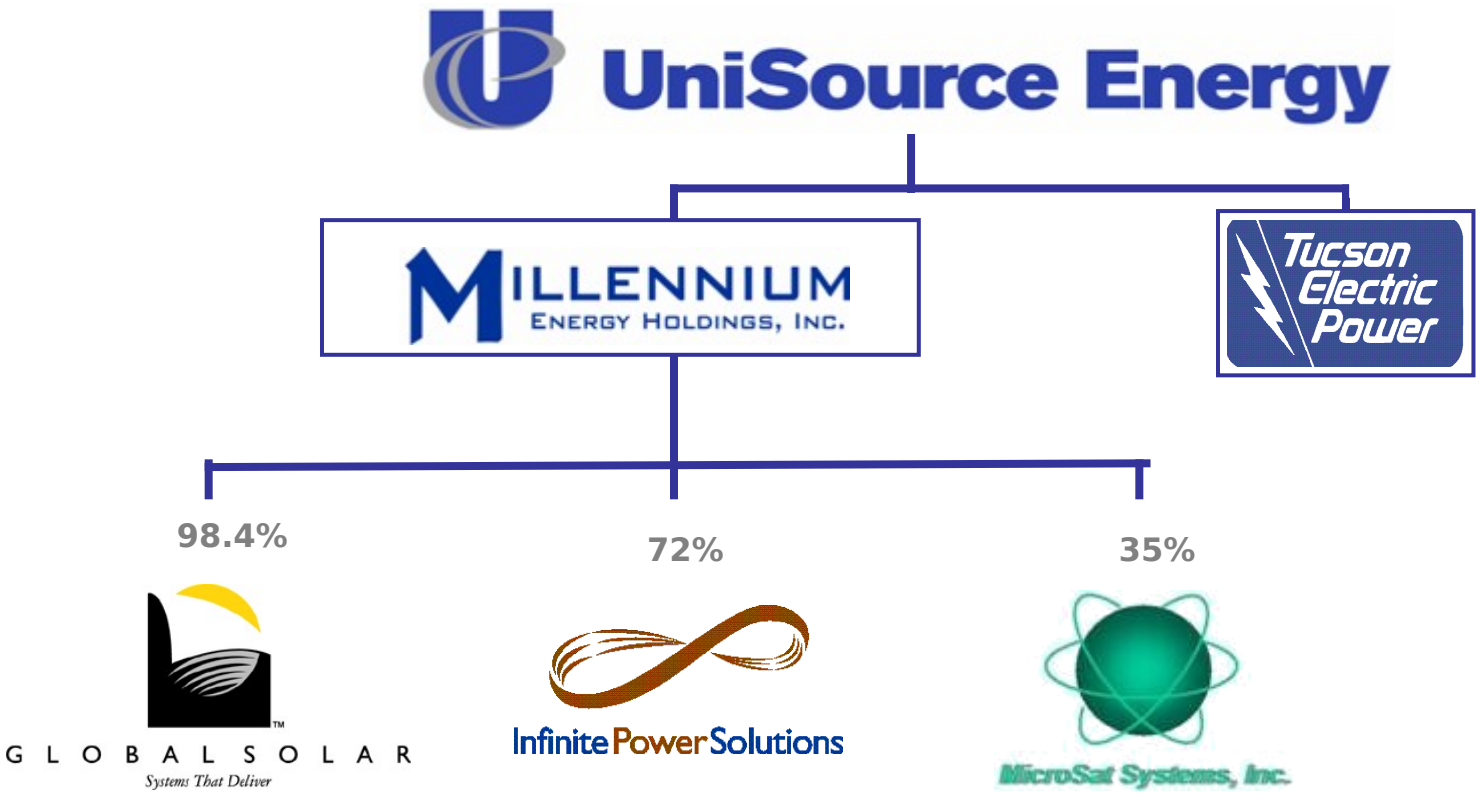
Agenda

- Global Solar
- Technology Attribute
- Product Features

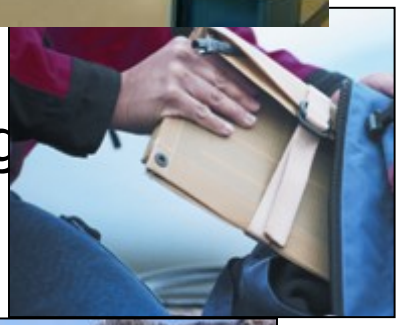
CORPORATE OWNERSHIP



Global Solar's Two Strategic Missions

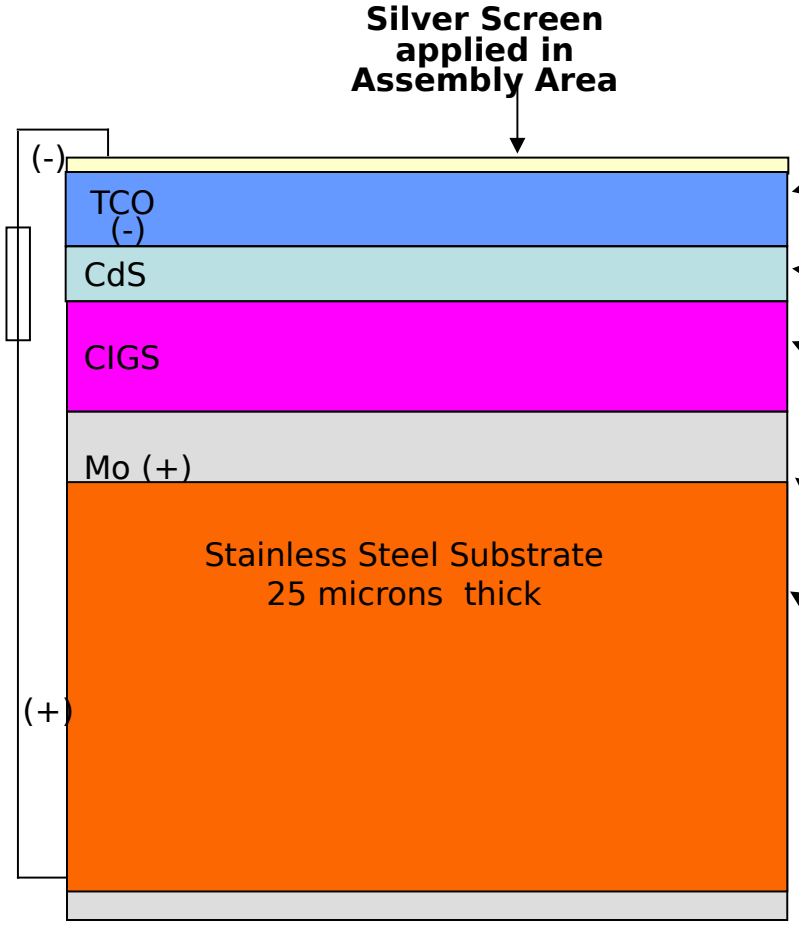
- **Expand Solar Market**: Capitalize on CIGS Uniqueness – Lightweight, Flexible
- **Expand Power Station Market:** Use Various Solar Products at present; Ultimately CIGS

Thin-Film PV Manufacturing (CIGS)



Turnkey Systems (VAR)

CIGS Solar Technology **overview**
(Stainless Steel)



Process Steps

Step 5 TCO (Indium Tin Oxide)
Top Conductor

Step 4 CdS (Cadmium Sulfide)
Window

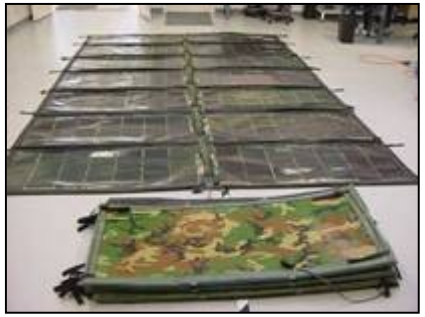
Step 3 CIGS (Copper Indium Gallium diSelenide)
Absorbing layer

Step 2 Mo (+) (Application of Molybdenum)
Back Conductor

Step 1 Selection and Preparation of Flexible **Stainless Steel** Substrate

Not Drawn to Scale

CIGS Manufacturing Process



TACs System

Portable Power Pack

❶ ❷ ❸ ❹

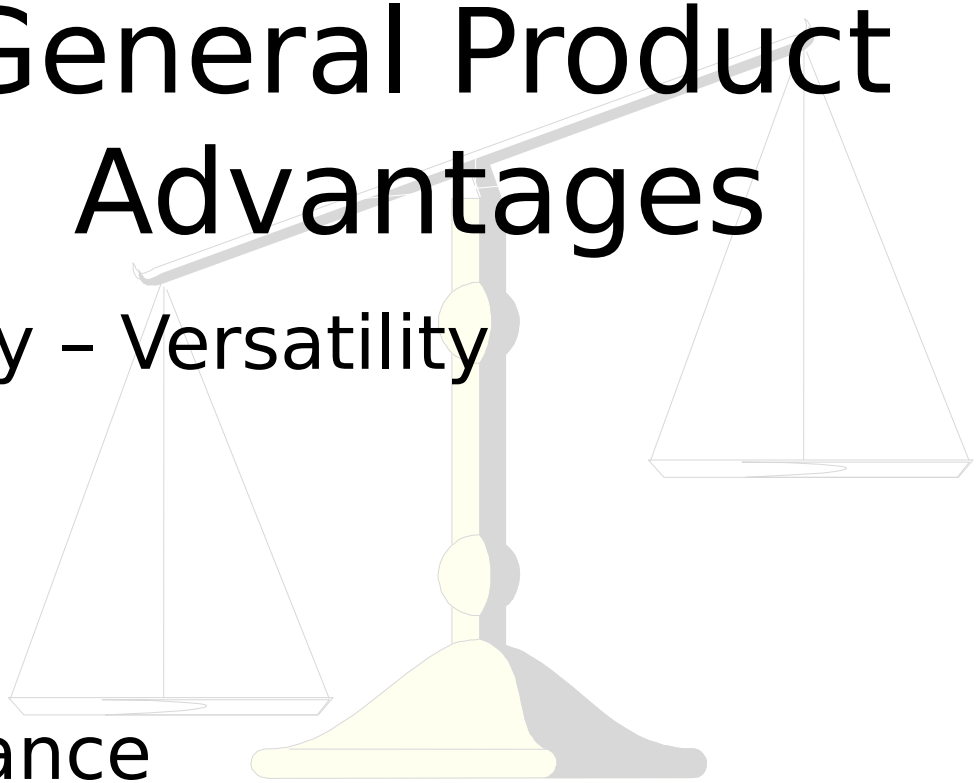
1. Thin-Film deposition of 300+ meter rolls

2. Cell / Submodule Manufacturing

3. Module Finishing

4. System Integration and Marketing

General Product Advantages



- Flexibility – Versatility
- Cost
- Performance
- Reliability

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PRODUCT BENEFITS FOR PORTABLE MILITARY USE

- **High Power-to-Weight ratios**
  - >2X Higher than other portable solar options
- **High Field Survivability**
  - Anti-Glare and Camo-versions
  - Silent Energy
  - No thermal signature at night
- **Minimizes Fuel Requirements**
  - Self-Sustaining Energy Source
  - Minimizes Fuel Logistics and cost issues

GLOBAL SOLAR PRODUCT OVERVIEW

- **Portable Power Packs (P3s)** (17-48 Watts)
  - Personal Electronics and Portable Computers
  - Portable, 24-Hour, Sustained Energy Supply
  - Survival kit Chargers
  - Anti-Glare and Camo Surface Treatments
  - Solarized Portable Water Purifier
- **Portable Power Cases** (100-800 Watts)
- **Tactical AC Systems (TACS)** (0.7 to ~8 kiloWatts)
  - Transportable Energy for Command & Medical Centers, Tents

PORTABLE POWER PACKS (P3s)

Lightweight, Foldable, Power source for
Fuel-Free, Portable Self-Sustained Power

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Product Advantages:

- **Recharges Batteries (BB390s and Others) to Enhance or Replace BA5590 usage.**
- **Enables Extended Periods in Field;**
- **Allows Fewer Batteries to be Carried into Field**
- **Solar m lbs., ~equiv. to 1ea. BB5**
- **No Fue e, No added logistics.**

CHARGING FIELD BATTERIES FOR SINCGARS (PRC-119) and VARIOUS OTHER FIELD EQUIPMENT

- Rechargeables like the BB390 replaces the BA5590, a widely used power source

LOGISTICS PAYBACK FOR SOLAR-RECHARGING MILITARY BATTERIES

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Benefits of Rechargeables, plus:

- Reduces number and total weight of batteries required on a mission
- Reduces procurement costs
- Reduced dependency on vehicle/generator; fuel use, fuel transport and emissions
- Increased security – small, portable and silent
- Reduces disposal challenges and expenses

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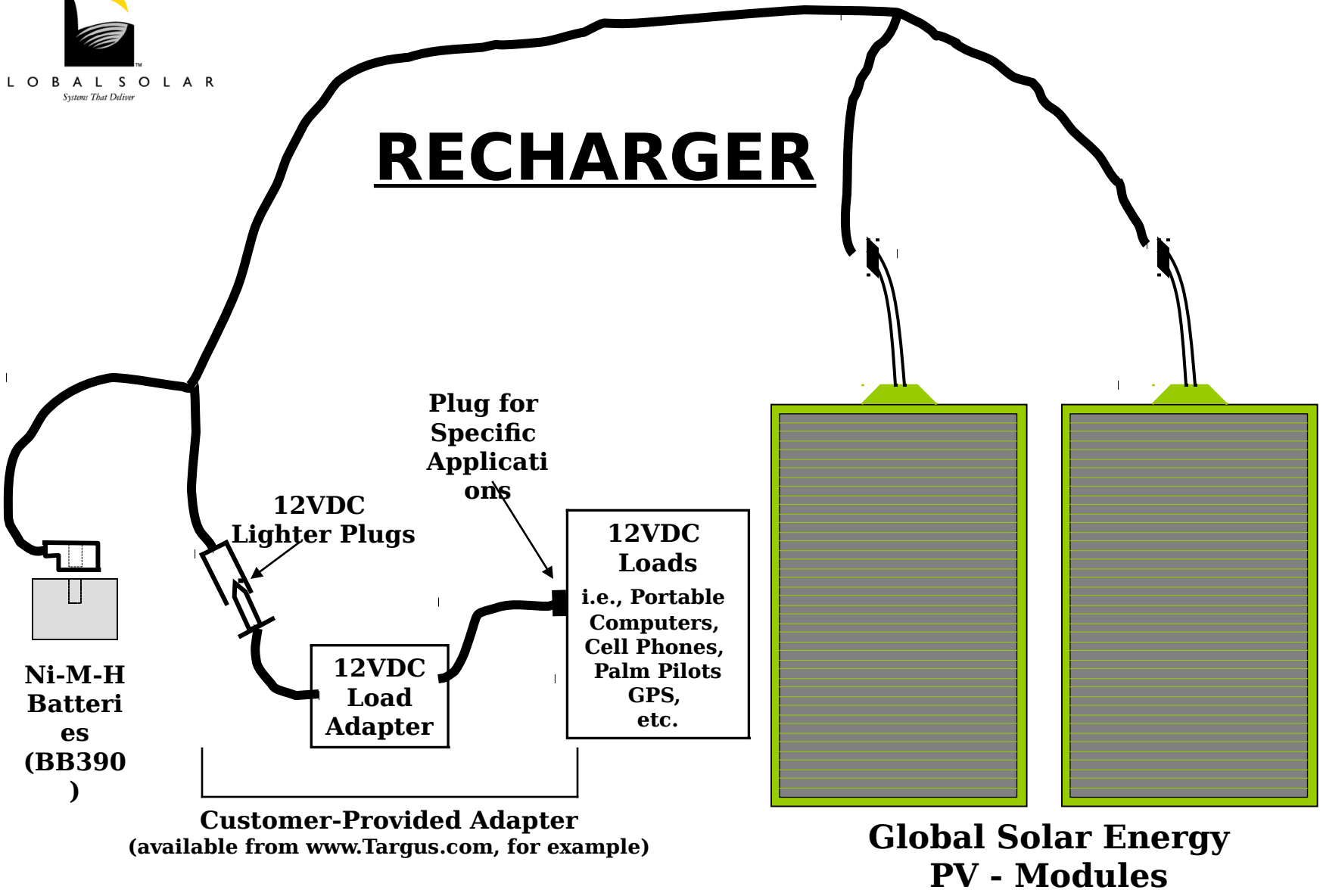
Systems That Deliver

RECHARGER



Solar 12VDC Self-sustained Power Source

FUEL-FREE, PORTABLE ENERGY FOR PORTABLE COMPUTERS

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- Enables extended Battery Life, OR
- Recharges Replacement Batteries

PORTABLE, 24-HOUR, SUSTAINED ENERGY SUPPLY

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- Tools, PCs, Cellula
- Radios, GPS
- Battery Charging
- Various Short Loa

"Solar-Charged, Portable Battery/Inverter supports 12VDC and 120VAC loads"

“SURVIVAL KITS”

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- Sized to fit Pilot Flight Suits
- Extends battery life indefinitely for signaling

Also available in International Orange for Dual-Purpose – Power and Rescue Signaling

Flipped Over for Signaling

ANTI-GLARE AND CAMOUFLAGE SURFACES

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SURVIVABILITY INCREASE

- 10X Lower Spectral Reflection
- Shading, Color-Blend

SOLARIZED PORTABLE WATER PURIFIER

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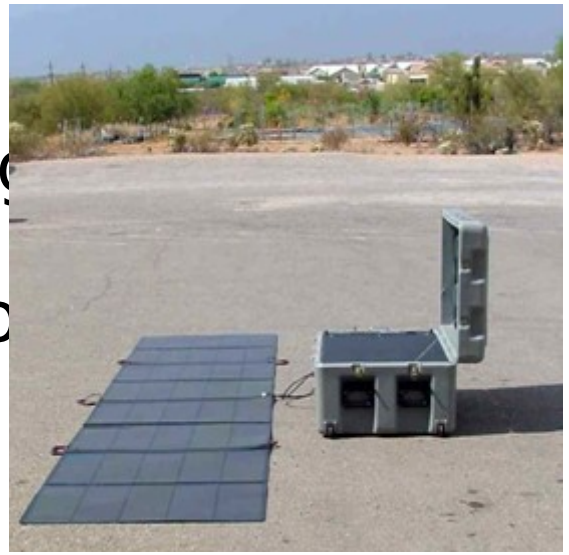
30 Watt Solar Panel

Solar Panel In Case

POWER CASE

TYPICAL APPLICATIONS

- 12 and 24VDC Water Purifiers (Aspen Water, Inc.)
- Portable, silent Energy center for Recharging Batteries in with Universal Charger
- High Efficiency DC Lighting
- Various Portable Loads Requiring 12 or 24VDC or AC (Inverter Optio



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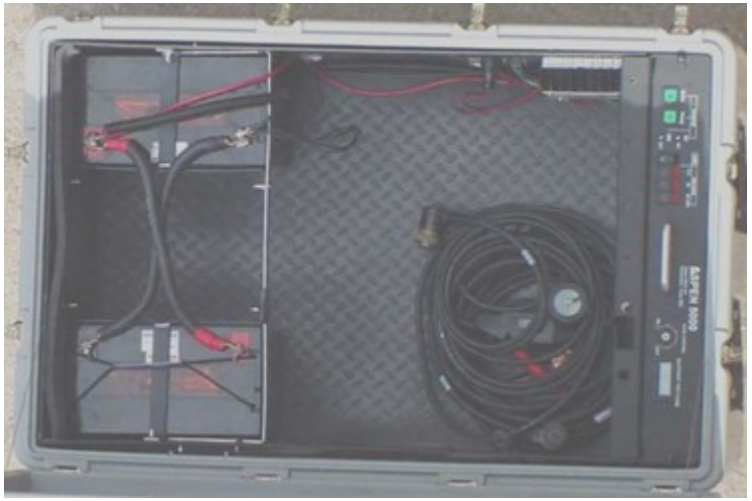
POWER CASE



- 100-800 Watts Solar
- 100-600 Amp-hr 12V Batteries
- 12 or 24VDC options
- Inverter Option for AC Power

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TACTICAL AC SYSTEM (TACS)

Hybrid Photovoltaic Array and Backup Generator
For Self-Sustained, Transportable, Power Source

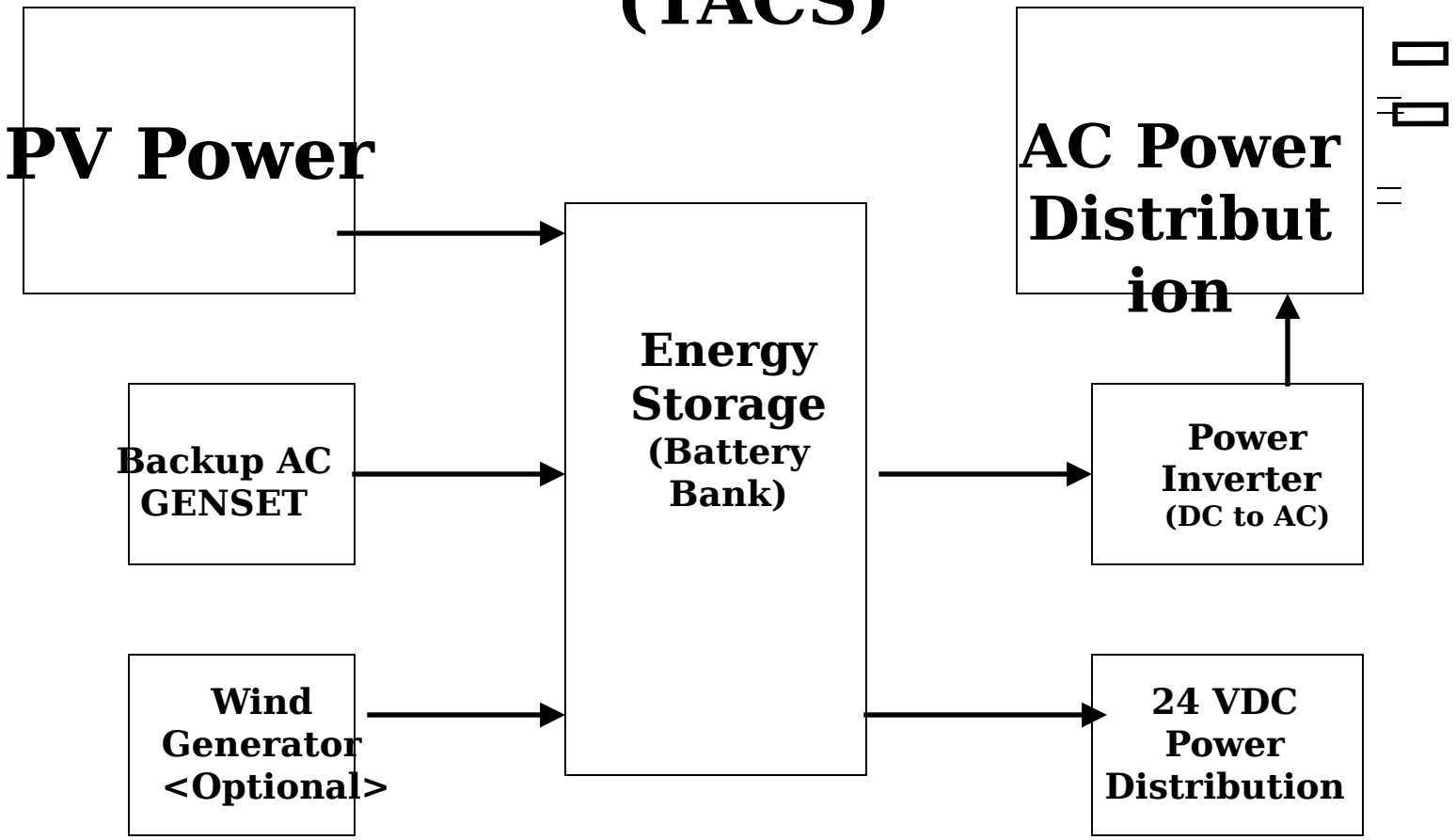
Substantial Reduction of Generator:

- **Fuel**
- **Maintenance (No Diesel “Wet-Stacking”)**
- **Usage (Long Periods of Silent Running)**
- **Pollution**

Overall Improvement in Logistics by Incorporation of PV Power Source

TACS SOLAR ARRAY DEPLOYMENT

Block Diagram of
Tactical AC System (TACS)



TRANSPORTABLE AC POWER

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TYPICAL APPLICATIONS

- Command Centers
  - Tent Lighting
  - Portable Computers
  - Coffee Pot
  - Battery Re-Charging
  - Copiers
- Medical
  - Lighting
  - Medical/Surgical Equipment
  - Environment Control

VERSATILITY OF TACS SOLAR ARRAY DEPLOYMENT

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Woodland Environment

Tall Grass and Weeds

Any Open Area

SOLARIZED TEMPER TENT

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Transportable
Expandable
Modular
PERsonnel Tent

PERFORMANCE EXPECTATIONS FOR 3 kW TACS (5KW Generator)

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FOR OPERATING LOADS, AS FOLLOWS:

- 6 Amps continuous, 120VAC

THEN AVERAGE SYSTEM PERFORMANCE, AS FOLLOWS:

- On-Time of Generator 10%
- Silent Running 85-90%
- 1/10Th the Fuel used Compared to Generator Alone
- <1/10th the Maintenance required Compared to Generator Alone
- Higher average loads require higher average generator on-times, fuel, and maintenance

Note: Assumes Spring through Fall in middle or low latitudes

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TACTICAL AC SYSTEM (TACS)

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For Self-Sustained, Transportable, Power Source

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- **Fuel**
- **Maintenance (No Diesel “Wet-Stacking”)**
- **Usage (Long Periods of Silent Running)**
- **Pollution**

Overall Improvement in Logistics by Incorporation of PV Power Source

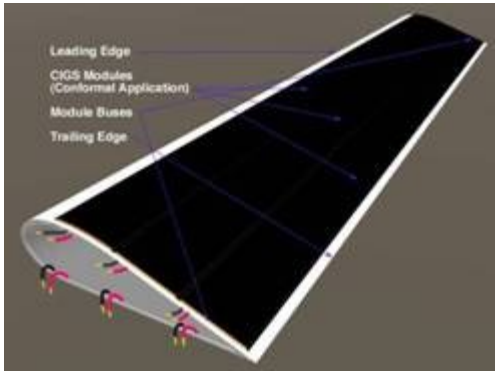
Attributes of GSE CIGS For Ultra-Light Aircraft

High Power to Weight Ratio

- Uncoated cells (~350-500 Watts / kg at 7-9 Watts / ft2, AM1.5)
- High Altitude and Space Arrays (~250-400 Watts / kg at 9.5-12 Watts / ft2 for space array and structure, AM0)
- Low Altitude (<~10K ft) Aircraft (~90-120 Watts / kg at 7-9 Watts / ft2 (AM1.5) for Easy to Adhere

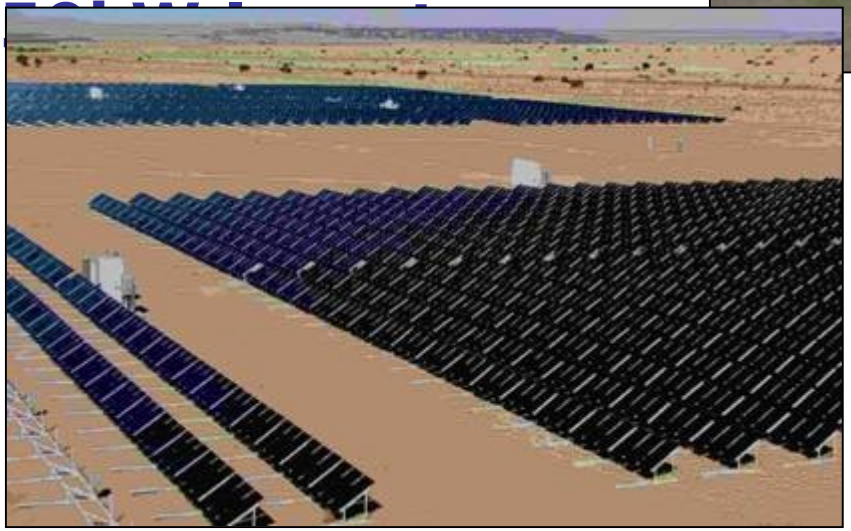
Solar Cells

Ultra-Lights



Springerville Generating Station

- Springerville, Arizona USA
- 3.4 MW DC
- Crystalline, Amorphous & CdTe Modules
- Grid-Tied
- 3-Phase, 34.5 kV
- 28 1



Commissioned:

- **1.4 MW - November 2001**
- **1.0 MW - September 2002**

In Process:

- **1.0 MW – 2003**

GLOBAL SOLAR PRODUCT RECAP

- **Portable Power Packs (P3s) (17-48 Watts)**
  - **Lightweight Battery Chargers**
- **Portable Power Cases (100-800 Watts)**
  - **Transportable, Independent Energy Source**
- **Tactical AC Systems (TACS) (0.7 to ~8 kiloWatts)**
  - **Larger Transportable, Self-Sustaining Energy System**

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SUMMARY

Lightweight, Portable, Solar Energy Products

Military-Specific Attributes

- High Power-to-Weight ratios
- High Field Survivability (Silent, Camouflage)
- Minimizes Battery and Fuel Transport

Solves Targeted Energy Needs Within Military

- Battery Recharging, Water Purification, Personal Electronics, PCs, Radios, Tools, Lighting, Transportable energy for command centers, medical, etc., survival kits
- Provides BOTH Cost-savings AND Improved Logistics